國立彰化師範大學 98 學年度碩士班招生考試試題

系所：光電科技研究所　　科目：甲、近代物理

☆☆請在答案紙上作答☆☆　　

PART Ⅰ.

1. Please explain the following terminologies in details. (15%)
   (a) Photoelectric effect
   (b) Bragg diffraction
   (c) Compton effect
2. Find the de Broglie wavelengths of a 46-g golf ball with a velocity of 144km per hour. (5%)
3. Find the energy levels of a 10-g marble in a box 5cm wide. (5%)
4. A hydrogen atom is $5.3\times10^{-11}m$ in radius. Use the uncertainty principle to estimate the minimum energy an electron can have in this atom. (10%)
5. X-rays of wavelength $10\,pm$ are scattered from a target. (a) Find the wavelength of the x-rays scattered through 45^{o}. (b) Find the maximum wavelength present in the scattered x-rays. (c) Find the maximum kinetic energy of the recoil electrons. (15%)

PART Ⅱ.

Some constants you may need:

- ✓ Planck's constant =6.626×10^{-34} J-s. Boltzmann's constant = 1.38×10^{-23} J/K.

1. (a) What is blackbody radiation? What is emissivity? (5%)
   (b) The surface temperature of an unknown star is 4000 K. We have known that the surface temperature of sun is 5800 K and the emission peak wavelength is 500 nm. What is the emission peak wavelength of the unknown star? What is the surface power density ratio between the unknown star and the sun? (5%)

2. (a) Consider some hydrogen atoms at certain temperature. Please calculate the ratio of atoms in the first excited state to the number in the ground state at room temperature and 6500 K, respectively. Assume the energy of first excited state is 10 eV above the ground state. (10%)
   (b) Consider some electrons moving inside n-type semiconductor materials. What kind of distribution are these electrons followed? You need to write the equation. (5%)

3. (a) Write down the time-dependent Schrödinger equation. Make sure to define every symbol in the equation. What can the Schrödinger equation be used for? (5%)
   (b) A particle having a mass of *m* and a total energy E, is incident into a step barrier of the form

$$V(x)=\begin{cases}0 & \text{x}<0\\ V_0 & 0>\text{x}\end{cases}$$

   Assume $E > V_o$. Please calculate the transmission (T) and the reflection (R) coefficient of this particle as functions of E, V_o and m. (15%)
   (c) Continue from (b). Please compare the transmission and reflection results with the classical expectations. (5%)